1.0 EXECUTIVE SUMMARY

Chevron has conducted several investigations in Hooven since hydrocarbon was first identified on the groundwater beneath the town in 1996. These investigations culminated in submittal of a human health risk assessment (HHRA) in May 2000 (E&E, 2000), which was approved by the U.S. Environmental Protection Agency Region V (EPA). The HHRA contained an evaluation (in Appendix D of the HHRA) which determined that the vapor intrusion pathway was incomplete. The current investigation was conducted to reevaluate the vapor intrusion pathway in response to a request by the EPA, Region V, in correspondence dated January 7, 2004. EPA attributed the additional review and request to updates in toxicity data for benzene and ethylbenzene and to heightened concerns surrounding vapor intrusion issues. Additionally, there is a RCRA requirement to complete an Environmental Indicator determination under CA725.

During March – May 2005, Chevron conducted a comprehensive investigation of the potential for migration of vapors from the Light Non Aqueous Phase Liquid (LNAPL)/dissolved contaminant plume to indoor air. One focus of the sampling effort was to characterize the vapor source area, and the potential migration pathway from the impacted groundwater/LNAPL (approximately 55 feet below ground surface [ft-bgs]). This effort included collection of samples of LNAPL, groundwater, and vertically nested vapor samples. The vertically nested vapor samples were collected both inside and outside the areas of the LNAPL/dissolved contaminant plume.

Individual constituents commonly found in gasoline that were identified in the LNAPL are also found in the associated dissolved contaminant plume and in deep soil vapor samples collected from immediately above the water table, 55-60 ft-bgs. Concentrations of these constituents attenuate rapidly with distance above the groundwater table as illustrated in the Site Conceptual Model (Figure ES-1). None of the constituents commonly found in gasoline were detected in soil-gas at concentrations exceeding semi-site specific screening levels provided in the OSWER Draft VI Guidance (EPA, 2002b) at depths between 20 and 60 ft-bgs in any of the five nested vapor probes located within the footprint of the LNAPL or dissolved contaminant plume. Soil vapors are attenuated within a short distance above the groundwater table and do not reach ground surface. In accordance with the OSWER Draft VI Guidance and consistent with previous risk assessments conducted for the site, the vapor intrusion pathway is incomplete and vapors from the plume do not migrate to indoor air in residences in Hooven.

This conclusion is further supported by two additional lines of scientific evidence demonstrating that biodegradation is the dominant mechanism for attenuation of the petroleum hydrocarbon constituent concentrations in the deep vadose zone (~30-55 ft-bgs). The first line of evidence is that the rate of decrease in constituent concentrations above the groundwater table is faster than that due to simple diffusion. The second line of evidence comes from soil-gas oxygen (O_2) and carbon dioxide (CO_2) concentration profiles collected above the LNAPL/dissolved contaminant plume. These profiles show decreasing O_2 and increasing CO_2 concentrations with depth indicating biodegradation activity. Mathematical modeling of vertical diffusion and biodegradation confirms the significant influence of biodegradation at this site. Collectively this evidence demonstrates that biodegradation is the dominant mechanism for attenuation of petroleum hydrocarbon constituent concentrations in the deep vadose zone within the plume footprint.

A second focus of the sampling effort was characterization of vapors in the shallow subsurface inside and outside of the plume area. A total of 75 sub-slab samples were collected inside (42 samples) and outside the plume area (33 samples). A total of 79 near-slab samples were collected inside (49 samples) and outside the plume area (30 samples). Samples were collected beneath homes with full concrete and combination concrete/dirt basements, and/or crawlspaces. Constituents commonly found in gasoline were detected in sub-slab and near-slab samples at similar low concentrations and at similar detection frequencies both inside and outside the plume. Sub-slab oxygen concentrations are also similar inside and outside the plume area. Sufficient oxygen is present to support active aerobic biodegradation. Volatile constituents that are not commonly associated with gasoline, and were not identified in the LNAPL or dissolved contaminant plume, were widely detected at low concentrations and at similar detection frequencies in the shallow samples both inside and outside the plume area as illustrated by the orange shading in Figure ES-1. In addition, methyl-tert-butyl-ether (MTBE), a gasoline additive that was not commonly used until after the Chevron refinery was shut down, was detected in some shallow soil-gas samples close to residences, but was not detected in any of the deep soil-gas samples collected directly over the plume. The shallow subsurface detections of common gasoline and other constituents are not associated with the plume at depth. Outdoor air samples collected during the project indicate that many volatiles, including constituents commonly found in gasoline, were frequently detected both inside and outside the plume area. Published studies and guidance documents (e.g. NJDEP, 2002; NYDOH, 2005; CA DTSC, 2005) state that many VOCs listed in the OSWER Draft VI Guidance are common at low levels in outdoor and indoor air, even in places away from groundwater or soil contamination. Because buildings exchange air with both the shallow soil gas around their foundations and the outdoors, it is reasonable to expect similar VOC concentrations in the shallow soil gas. In this study, soil gas samples were collected immediately proximal to home foundations (below or beside them) and as expected, VOC concentrations detected in the sub-slab and near-slab samples beneath Hooven homes and the atmospheric air samples collected around Hooven are consistent with the referenced studies. Therefore, with no complete pathway from Chevron's plume to the surface, the shallow soil vapors detected are attributed to background conditions related to human activities at the surface.

The initial step in conducting a risk assessment is determining whether a complete pathway exists from source to receptor. In this case the pathway considered is from the LNAPL/dissolved contaminant plume to indoor air. The results of this study support previous study results from Hooven that indicate that this pathway is not complete. Therefore the risk assessment for this pathway indicates that vapors from the contaminant plume do not present any measurable health risk to the residents of Hooven. Shallow soil vapors are attributed to surface activities and are not facility-related. Large studies of indoor air vapors at sites other than Hooven show that occurrence of low level background VOC concentrations are a common companion to human activity. Therefore, the primary conclusion of this study is that residents are not exposed to vapors originating from the plume that has migrated from the former refinery. Correspondingly, the results of this investigation demonstrate that the vapor intrusion pathway is incomplete and support a "YE" determination for the Environmental Indicator CA 725, i.e., human exposures are "under control" with respect to the vapor pathway in Hooven.

This diagram shows the general conditions under Hooven in cross section, including the geology, depth to the water table and distribution of hydrocarbons attributable to the former refinery.

Both the dissolved chemical and the vapor concentrations decrease to below detectable levels before they move very far from the LNAPL. For the vapors, concentrations decrease to below health-based screening levels a substantial distance below the ground surface.

The orange shading at various areas near the ground surface represents the zone of low concentration vapors that result from common human activities at the surface. These activities include the use of gasoline in vehicles and small engines as well as fuel oil to heat our homes.